ON

SOME REQUIREMENTS

IN

CLINICAL TEACHING

IN

DUBLIN.

BY

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As among the members of this Society are many whose labours in Clinical Medicine have largely advanced the Irish school, I trust that the following observations will be received with indulgence, and not attributed to any spirit of carping or fault-finding.

It is admitted on all hands that during the last half century a great school of Practical Medicine, Surgery, and Midwifery, has in Dublin grown to such dimensions, and established such a character, as to constitute at least one source of legitimate national pride, so much wanting in Ireland; a possession which to any country is more to be valued than wealth or power, or the barbarous triumphs of war.

But to all thinking men who have watched the rise, progress, and actual state of the Irish School of Medicine, the question presents itself—Are we, so far as modern methods of research are concerned, keeping up with the progress of medical science? are we standing still and drawing on our acquired prestige? or if advancing, are we not following merely the beaten path, irrespective of the growth of knowledge in other places? It must be confessed, looking at the body of literature relating to scientific medicine, that our share of it is comparatively small.

The term Scientific Medicine is one of late date, and is applied

[a] Read before the Medical Society of the King and Queen's College of Physicians, Nov. 16, 1870.

to that body of facts, or supposed facts, which have resulted from the employment of methods based on the use of physical investigation for the elucidation of health and disease, by which alone can be obtained or promoted the quality of exactitude in medical knowledge. But it does not, and ought not, to convey the idea that our predecessors were not scientific, or that their results, as tested by their application to the healing art, are to be contemned. In truth, the labours of the so-called scientific schools cannot be held, at least as yet, to be worthy of occupying a higher platform than those of their predecessors, so far as the treatment of disease is concerned; and it may be a question whether, during times when physical diagnosis and research were but little resorted to, a greater power, a larger grasp of mind, did not distinguish the physicians of past times from many of those of the present period.

It must be remembered that medicine advances in two directions; first, in the observation of those manifest phenomena of disease, whether or not influenced by therapeutic measures, which lie on the surface, and are, as it were, plain to the naked eye; and next of those which lie deeper, and whose existence, nature, and relations to the manifest, require for their elucidation the use of methods based on physical knowledge, by which alone scientific accuracy can be approached or attained.

It is in the latter direction that we are deficient. It seems to be quite natural, even perhaps to be desired, that certain schools should excel, or have a greater fame in some directions than others. But in a great school should any of the branches of applied science, —any mode of discovering truth—be conspicuous, by what may be virtually called their absence?

The modern or scientific method may be considered with reference to normal anatomy and physiology on the one hand, and to pathology, including morbid anatomy and therapeutics on the other. It is mainly in reference to the latter subjects that it bears on practical medicine. Now, as it is in this direction that the Irish school has advanced, we may consider the subject as in relation to the improvement of the healing art.

It is here that we are behind hand. The studies of structural anatomy, of pure physiology, and of organic chemistry, all-important as they are, have not as yet given us any great addition to our means of treating disease. But yet, although in these departments so little has been effected by the Irish school, that circumstance

should not detract from its high character in reference to practical medicine. What is wanting is a larger application of modern methods, such as the microscope, spectroscope, and organic chemistry, to the study of pathology, morbid anatomy, and therapeutics.

Some will say that by our system we have made many good physicians and good surgeons. Granted; yet is not this an inducement to seek to produce a still higher class, remembering that the phenomena of disease are to be studied like those of all other natural objects? If we wish to give our teaching the character of scientific accuracy, we must not neglect the methods which promote that end, and as we have attained a good position in practical medicine and surgery, so we should see that no means by which that eminence may be preserved or advanced is neglected.

The studies of pathology and of morbid anatomy in Dublin, have advanced in three directions—namely, in the observation of conditions which lie on the surface and are plain to the naked eye. And again, and with greater value and singular success, in the relation of these conditions during life to the symptoms and signs of disease. And lastly, in the record of the combinations of local changes. Of the importance of our results I need only point to the Transactions of the Pathological Society. That body has now been in existence for more than thirty years, and is steadily increasing in its numbers and utility; yet it must be admitted that in microscopic morbid anatomy, and in pathological chemistry, the results of its labours are comparatively small. Why is this? Why is the study of morbid anatomy and pathology in Dublin wanting in the use of methods calculated to ensure scientific accuracy? May it be that we have not begun from the bottom? Have we afforded our students the primary instruction or even the means of teaching themselves, or shown them that knowledge, which implies power, is advancing all around us and them, while we or they are standing still or advancing in but one groove? Or have they been shown the excellence of labouring for truth for its own sake, irrespective of its immediate consequences?

It will be superfluous to enlarge on the dimensions to which the various branches of scientific medicine have attained, and impossible to predicate to what limits they may yet extend. All its instruments are adapted to the study of the higher anatomy and physiology, as well as to that of disease, and the action of remedies. All have the one end—accuracy—each of them a means the more for the advance of the healing art. We may put aside the ophthal-

moscope, the laryngoscope, the stethoscope, and the endoscope, which last, thanks to the labours of Dr. Cruise, Dublin may almost claim for her own, and pass to the microscope, the spectroscope, and chemical research.

It will be unnecessary for me to dwell on the importance, the indispensableness of the latter methods of research to the solving of questions in physiology and morbid anatomy, especially in their relations to practical medicine. In truth, morbid anatomy, so far at least as changes of structure revealed by the unassisted eye, are concerned, seems almost to have reached its limits, and it must always be remembered that the changes thus observed are in most instances but advanced steps in the procession of diseased actions. How constantly are organs noted as being free from disease, in which a microscopic examination would have detected a great departure from health. Let those who are content that we should, in our schools and hospitals, go on in the old way, compare what has been done among us in microscopic morbid anatomy, with the labours of Ormerod, Bennett, and other British observers—to say nothing of Virchow, or of Cohnheim—in the direction of Physical investigation, as applied to practical medicine, and they will find it difficult to deny that great deficiencies exist in our system.

The study of medicine in its modern, or more scientific aspect, may be considered in reference to normal anatomy and physiology on the one hand, and to pathology, including morbid anatomy and therapeutics on the other. It is mainly in the latter direction that it bears on practical medicine. As the advance of Irish medicine has been almost exclusively in what has been called the practical direction, we may confine ourselves at present to the value of the scientific method in relation to the healing art. It is the deficiency in our schools and hospitals, as to the use of the scientific method that demands to be pointed out. In a few of our hospitals practical instruction is given by the medical officers to such students as choose to avail themselves of it, but we want a larger application of the modern methods to the studies of disease at the bedside, of morbid anatomy, and of therapeutics.

With respect to the Continental schools, especially those of Germany, there can be no doubt that in them a far greater number of labourers in scientific medicine exist than in Great Britain. This is in part owing to the difference in the institutions, and social conditions of the countries; and a large portion of the Continental

work is devoted to the study of normal structure and function, which has not as yet been productive of any great addition to our means of treating disease. Yet, every day is altering the relative numbers of workers at home and abroad, and it is at all events certain that while British investigators lean to the application of scientific research in a practical direction, they exhibit more of the modesty of true science than do many of our Teutonic brethren. They do not affect to occupy a higher platform than the investigators of other countries. They may be, as a late writer somewhat sneeringly remarks, in the class of the *autodidacten*. But are they the worse for that? May they not be the better?[a]

The addition of the spectroscope to our means of research promises results, the importance of which are incalculable, and it is not improbable that by its assistance many questions relating to essential, as distinguished from local disease, may yet be elucidated, especially when its results are taken in connexion with those of organic chemistry. Its marvellous powers of qualitative analysis are shown by the researches of Mr. Huggins, and Dr. Millar, into the chemical composition, even of the fixed stars, while its powers, as regards the composition of the colouring matter of blood are established by the researches of Professor Stokes of Cambridge, and of Hoppe. The spectral phenomena of blood, as shown by Dr. Letheby and Mr. Sorby, reveal its presence, whether the stain be recent, or of many years' duration. It is unnecessary to allude to the researches of

[a] In truth, the tone of superiority adopted by some German authors is simply offensive, not to British investigators only, but to those in other portions of the world In reference to this matter a writer in the Archives of Medicine, No. xvii., observes :—

"It has been truly said that Science is of no nationality, that a man who interrogates nature successfully, whether he works in Germany, or Siberia, or Mexico, in London, or Boston, at once becomes a Member of that great and ever-extending Republic, so pure that wrong is righted ere it merits its name; so perfect that every change, mighty or insignificant, is welcomed and adopted without producing the slightest strain. But such dreams must be dispelled. Germany has spoken. The investigation of nature's minutest and most delicate secrets, is her prerogative only. A new Republic is inaugurated; authority exacts submission, commands obedience. Masters must have docile pupils, and the pupils must accept, not doubt; obey, and not inquire; must worship and not dispute." . . . .

"A German author, whose work has just been translated into English, acknowledges the compliment paid by us to German microscopic work, thus gracefully:—'In the region of scientific medicine, the Germans enjoy at the present time an undisputed pre-eminence. Their medical books have taken possession of the markets of the world, and their larger schools are themselves like markets, in which representatives of all countries appear, in order to exchange gold for the higher culture.—*Professor Stricker, Nature—Sept.* 1, 1870.'"

Dr. Bence Jones, and other English observers, but it appears more than probable that before it can be affirmed that the nature of all essential diseases is as fully investigated as our powers will admit of, the blood in these affections, and in different stages of these affections must be submitted by competent observers to a searching microscopic and spectroscopic examination.

The deficiencies in our school as to the modern scientific medicine may be considered in two points of view.

First, the small amount of original work it has produced. We have, it is true, a few labourers in this direction. Their names will occur to every one, and they deserve all honour, not for the high value of their labours only, but for their pursuing their inquiries, based on physical science, in various directions, without example and without assistance.

Secondly, we must look to them in relation to the teaching of the crowd of students which annually frequents the schools and hospitals of Dublin. Here, indeed, we have but little to show. It has been attempted to form microscopic classes in the University and in the Royal College of Surgeons, but the success of these efforts has been of a shadowy nature, and for an obvious reason—namely, that one great element of interest to the student must necessarily be withheld if we look to the practical application of scientific medicine. Instruction of this kind, which is confined to a school, has no necessary connexion with hospital study, and it is deprived of its demonstrative character in relation to disease and its results, watched in the wards, and investigated in the dissecting room of the hospital. Such a mode of instruction is deficient in value as to its application, and so must want interest.

Now, putting aside the Palatial institutions which are on the continent in connexion with the great hospitals, for the scientific study of clinical medicine, let us look nearer home and we must admit that, compared with London and Edinburgh, Dublin is deficient not alone in the investigation of disease by the modern application of physical science, but also in affording means of instruction to the students in this direction. The names of Queckett, of Beale, of Bowman, and of Carpenter, recall the labours of the London school. At Edinburgh, Professor Bennett has nobly shown how medical observation and progress are promoted by physical research, and he has established a physiological laboratory, which is attended by a large class of students. In that stately and beautiful structure, the New Museum at Oxford, exist the most complete

arrangements, available to every student for all studies based on physical science in physiology and pathology, while at Cambridge similar arrangements have been completed on a liberal scale.

It is clear that if we desire to keep up with the progress of science in its application to medicine, we must base the effort on the teaching of our students, and trust to time for the development of men, who though at first but few out of many, will ultimately stand out in relief and become themselves teachers and discoverers *We must henceforward provide instruction in all the methods by which physical science is brought to bear on the advance of medicine.* Our school teachers and our hospital officers, and especially the latter, must see to this, for they have the opportunity of showing how the application of physical methods elucidates the phenomena of living disease, and so subserves the art of healing. Hospitals should not be considered merely as means of teaching elementary medicine and surgery. In them are to be met infinite complications relating to disease, the saving of human life, the alleviation of human suffering, and the whole subject of therapeutic science. We are bound to show how physical science every day enlarges our means and subserves those ends.

The medical officer of a clinical hospital should not be content with merely permitting his students to follow his teaching and his practice in the daily work of the wards. It is true that by observation and self-instruction they in many cases derive great advantage in becoming qualified for the ordinary routine of practice. But more is necessary, and a larger view of the relations between the teacher and the student seems requisite. Hospitals should be schools for the general enlargement of the mind, schools of applied ethics and applied science, and it becomes our bounden duty to train the students' minds by the use of all scientific methods of observation to the practice of exactitude and the habit of definite thought. The work must not be done grudgingly, and we may hope to see established in every hospital in Dublin a Physical laboratory furnished with such apparatus and appliances as the science of the present day requires for the investigation of disease. Even if nothing more than this were done, and the class were supplied with the means of instructing themselves, a great reform would be effected, promoting the advantage of the patients and the students, and also the future character of the Irish school. But more is necessary, and we may trust will ere long be accomplished.

In these countries, owing to various circumstances, we are not yet in a position to follow the example set us in the great schools of Vienna, Berlin, Breslau, and even Stockholm, where arrangements exist, the completeness of which may be taken as a measure of how far those places are a-head of us, in the scientific study of medicine. To the great hospitals are attached spacious and richly provided buildings, with theatres for instruction, and laboratories for practical work, in which every pathological specimen is submitted to the most advanced physical examination, optical and chemical, by eminent pathologists. Records are kept of every microscopic and chemical result. The hospital class is instructed by the professor, while assistants train the students to practical work in the laboratory, or show them the application of the physical methods to the cases in the wards. Thus they are taught how to observe, how to connect the physical with the vital phenomena, how to think, and how to discover, and all this outside the pursuits of the higher anatomy and physiology, for which the hospital is less fitted than the school.

In our first attempts at making such arrangements in the Dublin hospitals, no great amount of expenditure will be necessary. A commodious and well-lighted room within the walls of the hospital is requisite. This should be furnished with a few microscopes of moderate power, one of which may be fitted with a spectroscope; a limited chemical apparatus for qualitative analysis, with fitting re-agents, a washing stand and arrangements for the safe-keeping of instruments, which in time would include the ophthalmoscope, laryngoscope, and endoscope, are all that in the first instance would be demanded. A few standard works, such as those of Beale, Bennett, Carpenter, and Parkes, might form a library of reference, which should be kept in the laboratory, so as to be always at hand.

Already, in consequence of a representation of the medical officers to our enlightened Board of Governors, a physical laboratory is in course of preparation at the Meath Hospital. Mr. Spencer, of Grafton-street, will furnish the instruments, and advise upon the general fittings. In the Richmond Hospital a similar arrangement is in progress. Putting all other considerations aside, it may be anticipated that by the facilities which the medical officers will thus have in the diagnosis and treatment of disease, the sick poor in hospital will be greatly benefited. In private practice the service of the expert can be always, at least in cities, commanded; but as regards the poor the case is widely different, and it may be, that under the proposed

arrangement, by which it will be possible even in the one case to have repeated physical investigations carried out, the position of the patient in hospital may be better than in private practice.

But it is necessary that something more should be done than the making provision for the self-instruction of the students, and this opens up some considerations, the importance of which is very great. There can be little doubt, so far as our University students are concerned, that a certain portion of them would largely profit by the physical laboratory established in the hospital, and by the library of scientific research. But it is to be feared that many of the class would not have had that previous instruction in physical science which would enable them to understand the nature of the necessary instruments, the value of the phenomena displayed, the mode of reasoning on them, nor even the terms employed. Such is the result of the so-called preliminary educational system, which in general may be taken to imply an education preliminary to the stoppage of all general training of the mind.

If the establishment of the Physical laboratory in each hospital of instruction be carried out, it will become necessary, for more reasons than one, that an officer or officers should be appointed, whose duty would be to take charge of the laboratory and its apparatus, to train the student in the use of instruments, to assist them in making observations, while, by free access to the cases, he would be able to give to his teaching the value and interest of demonstration in regard to clinical medicine. It is not to be expected that the senior physicians and surgeons of an hospital could be so conversant with the modern modes of physical inquiry, as to be able to train the students in these directions. Their function is to teach them how to reason on the phenomena thus observed, and as the officer in question must act as referee or consultant to the physician or surgeon, in every case requiring advanced physical investigation, he must have passed the pupillary condition, and have become a member of the profession. Such an officer should have full opportunity of carrying on and even of publishing whatever original investigations he might choose to follow, for by this alone can he be elevated from the position of a servant to the rank of an independent scientific man.

That arrangements of this kind would greatly enlarge the scope of our hospitals, as places of professional study, and eminently advance the character of the Irish schools, must be obvious to all. That they will sooner or later be effected, is tolerably certain.

Such appointments might be made to be held for a definite time, say from three to five years, and then every hospital of instruction in Dublin would be able to furnish the profession, not merely with the ordinary class of medical students, whose admission into the hospital implies the payment of a fee, and who must be incompetent to benefit the pupils in the way of instruction, the physician in the way of observation, and medical science, in the way of original research, but with young medical men experienced in disease, and experts in the scientific study of medicine.

In many of the London hospitals officers of this kind are now appointed under different designations; in one institution in Dublin, the Mater Misericordiæ Hospital, appointments of this nature have been lately created; while in Germany the office of *Privatdocent* corresponds to that which has been indicated.

If we consider the life of a professional man who has to live by his practice, it must be admitted that the opportunities being given, the most fruitful period for the augmentation of that knowledge, which will make him eminent as an observer or a discoverer, is the time while he is still young, emancipated from the toils of a coercive education, and before he becomes burdened with the cares of his profession.

By adopting the course which has been indicated, it is evident that the utility of our hospitals would be greatly enlarged, as it would extend to a much higher class of students than those who at present frequent our wards. These latter too would receive a greatly enlarged education, and the result to the country and to science would prove of the highest value. And it is to be remembered that the main consideration which induced the House of Commons to continue the hospital grants for Dublin, was their importance to the country in an educational point of view.

There are at least ten independent hospitals of instruction in Dublin, each with its own traditions, customs, and methods of study. To this circumstance much of the success of the Irish school is attributable. If each of them were able to send out every three or five years, one or two of such highly trained men, what an advantage it would be, and what an impulse would it give to the cause of scientific research in our country; and what a great advantage it would be to the sick poor in hospital, if the physician had at his hand the means and the power of elucidating questions which require the application of all or any of the means of physical

research. It is not to be held that the microscope or chemical analysis are not in use in our hospitals; but the system is imperfect and unsatisfactory, as regards the general character of the school.

In thus seeking to enlarge the scope of our hospitals as places of medical study and advancement for those already qualified to enter the profession, certain difficulties will have to be encountered. But progress controlled by judgment will in the end prevail. If from circumstances easily to be appreciated, the officers of an hospital, many of them no longer young men, all of them engaged in, or looking for practice, cannot afford time for the study or teaching of those branches of the subject, which are necessary in the present advanced state of pathological science, why should not full provision be made for assisting the hospital officer in the necessary instruction of the student? and why should our hospitals remain as sealed books to so many who are ready and willing to avail themselves of the opportunities therein afforded of original investigation?

An objection to arrangements of the kind has been raised, which is somewhat singular. It is that young men who may have served in these offices, might be held to have thereby established what is termed a claim to be elected into a higher office at some future occasion. Granted it would be so, and what then? Will it not be of the greatest advantage to any board of electors that among the candidates for the honour there should be individuals whose labours have added to science, and whose success in teaching has advanced the school and reflected honour on themselves. And surely the greater number of such candidates as may present themselves, the better for the hospital, for the country, and for the reputation of the school.

But as regards the whole subject there remain one or two considerations to be dealt with. For some years past the mind of England has been largely turned to the importance of Preventive, as distinguished from Curative medicine. In 1867, the British Medical Association held a memorable meeting in the University of Dublin. On the report of the Public Health Committee being brought up, it was advocated that the Association should apply to Government to appoint a Royal Commission to inquire into the state of the sanitary law throughout the kingdom, with a view to legislation. The commission was appointed. It was subsequently recast, and it was thought advisable that its

inquiries should be confined to the state of the sanitary law in England. Doubtless a similar course will be taken as regards the remaining divisions of the kingdom. That commission under the chairmanship of Sir Charles Adderley, M.P., has laboured with signal energy, and its report will be ready for the approaching session of Parliament. The confused mass of sanitary laws will be consolidated. Enactments may be hoped for calculated to preserve and improve the health and well-being of the community at large, and we may look for laws which will constitute some of the most enlightened enactments of the Government. For all those who will be employed under this law, the necessity of the use of physical methods is obvious. If the medical profession desires to keep in its hand the administration of the great interests and the practical application of Preventive Medicine, it behoves us to see that our students are prepared to take office under a system which will involve a large application of physical knowledge; for reports on microscopical, chemical, and meteorological questions, will be constantly required. This commission, the first fruits of the long and enlightened advocacy of Dr. Rumsey in favour of a large and comprehensive system of state medicine, is not likely to adopt all the theories of some sanitarians, in respect to the etiology of diseases or our power of preventing epidemics. Its members will seek to bring before the State the importance of promoting the health and well-being of the community at large, by providing them with pure air, pure water, unadulterated food, and wholesome dwellings. These objects involve the questions of sickness, mortality, nuisances, over-crowding, drainage, habits, food, water supply, ventilation, epidemics, vaccination, contagion, endemical disease, and occupation. By regulating the laws relating to these matters, and by bringing them up to the state of present knowledge, it is hoped confidently, that an improved condition of public health will be produced, by which the population will be better able to resist epidemical or endemical disease, or when it does come to bear it better.

In contemplation of this the University of Dublin has instituted a diploma in state medicine of a high class; the candidate for which must not only be fully qualified in arts and medicine, but will be liable to be examined in pathology, and in vital and sanitary statistics, engineering, chemistry, natural philosophy, meteorology, and forensic medicine.

To conclude, I have endeavoured to call the attention of those who

are interested in the prosperity and future usefulness of the Irish School of Medicine, to the fact that in Dublin we have kept pace with other schools in but one direction, while in experimental physiology, in organic chemistry, and in the use of physical methods in advancing practical medicine, we are so far behind hand. I believe that this is owing to neglect of practical instruction in relation to hospital study, or at least to the want of those means by which the student might, to some degree, educate himself. We have not been reading the signs of the times, and it is plain, at all events, that these matters should be seriously considered by us all.

Let me not be understood, however, as seeking to depreciate that body of practical medicine which—advancing since Hippocrates—has grown to such dimensions, even before the times of Avenbrugger and Laënnec. What is wanting is the wider admission of the great truth, that—in the development of the highest attribute of the physician, the power almost instinctive in diagnosis, prognosis, and treatment—the various physical methods give a priceless means, the more of arriving at and securing that scientific accuracy, the value of which to the well-being of man is simply inestimable.

Since the reading of this paper I have received a communication from Professor Stokes, of Cambridge, some extracts from which will be read with interest, as referring to the question as to how far the spectroscopic examination of blood might be expected to throw light on essential as distinguished from local disease:—

"Cambridge, *December 27, 1870.*

"Purple cruorine is an active absorber of oxygen, while the scarlet is, for an organic substance, an active oxydizing agent. Naturally it does not come up to such powerful inorganic oxydizers as peroxide of hydrogen or permanganate of potassium. Thus urea, which is easily oxydized by permanganate of potassium, does not get oxydized in the circulation, but needs to be eliminated by the kidneys.

"3. It is not to be expected that in diseases more than a very small portion of the cruorine should be altered. Any extensive alteration could hardly, it seems pretty certain, be compatible with life. Consequently, if the spectrum of diseased blood be examined, the observer must expect to encounter *in the main* normal cruorine. This acts so powerfully and so distinctively on light that the chief features of the spectrum will be those of normal cruorine. But as this substance is pretty transparent for some parts of the spectrum—transparent, for example, to a very considerable degree for the greater part of the red—it is possible that febrile blood might show something which would be indicated by a new

band in this part of the spectrum. In short, the observer is not to expect to find the spectrum of normal cruorine absent or changed, but, over and above the bands due to normal cruorine, he *may* find a band or bands in the part of the spectrum which it leaves unattacked.

"One such band in the red, not indeed seen directly, but produced by the action of a re-agent, seems to me very likely to occur. I have often thought of taking the matter up, but never have done so. Will you do so, as you have the opportunities afforded by large hospitals?

"If hydrosulphate of ammonia be added to a dilute solution of normal blood, with or without the previous addition of an alkaline carbonate, no immediate effect is produced, but in a few minutes at the outside the scarlet cruorine (or rather hæmoglobin) is reduced to the purple or deoxydized.

"But if gallic acid, with an alkaline carbonate, be first added to the blood solution, and then after a little while hydrosulphate of ammonia, instantly a very distinct band is developed in the red not attributable to either hæmoglobin (cruorine) or to hæmatin, either oxydized or reduced. There are other substances besides gallic acid which, when used in a similar way, cause the appearance of this band. If a solution of normal blood be left standing till it has begun to putrify, the addition of hydrosulphate of ammonia at once develops a similar band. It would be interesting to observe whether freshly drawn febrile blood would agree with putrifying blood in this respect. The observer can familiarize himself with the band by adding gallic acid to a solution of normal blood.

"I have obtained some evidence that, whereas in its action on the substances introduced into the blood from the food, scarlet hæmoglobin imparts to them its semi-free oxygen, oxydizing them while it is itself reduced, and is then re-oxydized in passing through the lungs, in the case of gallic acid, on the other hand, the oxydized hæmoglobin forms a permanent compound with the gallic acid—a compound which does not split up into reduced hæmoglobin on the one hand, and products of oxydation of gallic acid on the other. The appetency of gallic acid in an alkaline solution for oxygen seems satisfied by its entering into a combination with the oxydized hæmoglobin.

"I should have said that we have optical evidence of the formation and existence of this compound in the removal of the absorption bands of hæmoglobin, whether of the oxydized or reduced, when the gallic acid is used in excess; but the new spectrum shows nothing distinctive till hydrosulphate of ammonia is added. With a smaller quantity of gallic acid a portion of the hæmoglobin would remain free, and show the behaviour of normal hæmoglobin, while another portion would be engaged, and would show the new band on the addition of hydrosulphate of ammonia.

"When blood putrifies, I suspect that some of the products of putre-

faction behave like gallic acid, entering into combination with oxydized hæmoglobin, instead of reducing it and being themselves oxydized by it. And the same may, perhaps, be the case in instances of low fever, even in the circulation. If so, the hæmoglobin so engaged would be clogged, as it were (the word is to be understood in a chemical not a mechanical sense), and rendered incapable of discharging its normal functions. It would be an interesting point to determine; and if evidence were obtained of the existence of such a compound, the investigation might even throw light on the theory of remedies.

"From what you tell me of extreme cases, I think it very likely that in such cases, at any rate, the addition of hydrosulphate of ammonia, and immediate spectroscopic examination, would reveal an abnormal condition of the blood. The blackness in the form of fever which you have lately had in Ireland, I should suppose to indicate insufficient oxydation, perhaps from a portion of the blood being in a putrid state, and so making abnormal demands upon the supply. The detection of insufficient oxydation would demand special precautions in the manipulation, so as to avoid access of oxygen by exposure to the air. I should have more expectation of useful results from the hydrosulphate of ammonia test.

"Hæmoglobin is a very unstable substance, at least very easily decomposed by certain re-agents, acids especially. It is difficult to dry it without more or less decomposing it. With certain preventions I believe it may be dried, and when once dried may be kept in a dry state without decomposition. I should question whether such circumstances are likely to occur in a casual blood stain.

"But hæmatin, which is the coloured product of decomposition, is an extremely stable substance, and it yields spectra hardly less distinctive and delicate as tests, than those of hæmoglobin itself.

"I have called the substance hæmoglobin rather than cruorine, because I think Hoppe-Seyler has a right to name it, and he has called it hæmoglobin.—Truly yours,

"G. G. STOKES."